Paralysis promises smart silk technology

September 19 2013

The silk worm (Bombyx mori) spinning.

(Phys.org) —Oxford University researchers have harnessed the natural defence mechanism of silkworms, which causes paralysis, in what is a major step towards the large-scale production of silks with tailor-made properties.

Professor Fritz Vollrath and colleagues from the Oxford Silk Group at Oxford University's Department of Zoology collected silk directly from paralysed silkworms by injecting a chemical that is naturally produced by the animal. In the wild silkworms produce this hormone when they

are injured since, as they move their bodies through hydrostatic pressure, without this self-induced paralysis their wounds would get worse and they would risk 'bleeding out'.

The team's report in the journal *Biomacromolecules* this week concludes that, in comparison to unparalysed silkworms, paralysis allows longer and more consistent silks to be collected by eliminating the ability of the silkworm to break and alter its silk fibre.

The direct 'forced reeling' of silk has been used in spiders for many years. However, reeling large amounts of silk directly from silkworms has not previously been possible. By tricking the silkworm into performing its natural response to injury and becoming paralysed the Oxford scientists show that it is possible to reel hundreds of meters of silk under full control.

Unlike unravelling cocoons, as in the silk textile industry, silkworm forced reeling allows the silk properties to be modified to suit particular purposes. This has important implications for the large-scale reeling of silkworms for industrial production of environmentally-friendly fibres for use in a range of applications – from biomedical implants through to super-tough composite panels.

Silkworm paralysis may open the door to a range of silk technologies, using these animals which, unlike spiders, can be farmed at high-densities. Reeling of silk from paralysed worms is the subject of a recent patent, which also highlights the exciting potential for genetically modifying silkworms to induce paralysis 'on-demand', a particularly useful feature for mass-rearing.

'This is an interesting result as the paralysis prevents the silkworms breaking the fibre, but still allows silk spinning and collection,' said Beth Mortimer of the Oxford Silk Group, an author of the report.

'The commercial implications of this process are self evident: now we can make silks to order by manipulating the mechanical properties while at the same time adding functionality,' said Professor Vollrath.

Dr Alex Woods, an entomologist and Oxford-based medical researcher responsible for the original discovery said: 'importantly, this may allow us to make high-quality silks with a variety of desirable mechanical properties, in practical quantities, to finally expand this exceptionally well-suited biomaterial into key medical applications.'

A report of the research, entitled 'The forced reeling of Bombyx mori silk: separating behaviour and processing conditions', is published in this week's *Biomacromolecules*.

More information: pubs.acs.org/doi/abs/10.1021/bm401013k

Provided by Oxford University